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Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re Application of:

James M. Cleeves

U.S. Serial No: 09/746,341

Examiner: Cruz, Lourdes C.

Filed: December 22, 2000

Art Unit: 2827

For: CONTACT AND VIA
STRUCTURE AND METHOD OF
FABRICATION

Assistant Commissioner for Patents
and Trademarks
Washington, D.C. 20231

AMENDMENT AND RESPONSE

Dear Sir:

This is in response to the Office Action mailed March 4, 2002. Applicant respectfully requests the Examiner to enter the following amendments and consider the following remarks.

FIRST CLASS CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Assistant Commissioner of Patents, Washington, D.C. 20231

on June 4, 2002

Date of Deposit

Teresa Edwards

Name of Person Mailing Correspondence

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Signature

June 4, 2002

Date

IN THE CLAIMS

Please cancel claims 16-25 without prejudice.

Please amend the following claims and add new claims 27 and 28:

1. (Amended) A contact comprising:

a conductive film;

A1
an opening formed through a plurality of film stacks, said opening having a top and bottom wherein said bottom is formed on said conductive film, said opening having a first sidewall and second sidewall wherein said first sidewall is opposite of said second sidewall, and wherein said first sidewall has a stair step configuration wherein said first sidewall is closer to said second sidewall at said bottom of said opening than at the top of said opening; and

a continuous conductor formed on said stair step configuration said first sidewall of said opening and on said bottom of said opening on said conductive film.

2. The contact of claim 1 wherein said second sidewall has a second stair step configuration.

3. (Amended) The contact of claim 1 wherein said continuous conductor is aluminum or aluminum alloy.

- A2
4. (Amended) The contact of claim 1 wherein said first sidewall has a slope of less than 2:1.

5. (Amended) A contact comprising:
a contact opening having a bottom on an interconnection, said contact opening having a first and second laterally opposite sidewalls, wherein said first sidewall comprises:
a first vertical side extending up from said bottom;

a first horizontal surface extending from said first vertical side to a second vertical side, said second vertical side further spaced from said second sidewall than said first vertical side;

a second horizontal surface extending from said second vertical side to a third vertical side wherein said third vertical side is spaced further from said second sidewall than said second vertical side; and

a continuous conductor formed on said first sidewall and on said interconnection in the bottom of said contact opening.

6. (Amended) The contact of claim 5 wherein said conductor is an aluminum or an aluminum alloy.

7. A contact comprising:
a first film stack having a first part and a second part separated by a first gap, said first film stack having a top conductive film;
a second film stack formed on said first film stack, said second film stack having a first part and a second part separated by a second gap formed over said first gap so as to expose said top conductive film of said first film stack, said second film stack having a top conductive film; and
a continuous conductive contact film formed on said top conductive film on said second film stack and on said top conductive film of said first film stack in said second gap.

8. The contact of claim 7 further comprising a third film stack having a top conductive film, said third film stack formed over said second film stack, said third film stack having a first part and a second part separated by a third gap over said second gap wherein said third gap is larger than said second gap so as to expose said top conductive film of said second film stack and wherein said continuous conductive film is formed on said top conductive film of said second film stack in said third gap.

9. The contact of claim 7 wherein said first film stack comprises a top P+ silicon film formed on a silicide film which is formed on a P+ silicon film which is formed on a P-silicon film which is formed on a antifuse layer.

10. The contact of claim 9 wherein said second film stack comprises a top N+ silicon film formed on a silicide film which is formed on a N+ silicon film which is formed on a N-silicon film which is formed on a antifuse film.

11. The contact of claim 7 wherein said first film stack comprises a top N+ silicon film formed on a silicide film which is formed on a N+ silicon film which is formed on a N-silicon film which is formed on a antifuse film.

12. The contact of claim 11 wherein said second film stack comprises a top P+ silicon film formed on a silicide film which is formed on a P+ silicon film which is formed on a P-silicon film which is formed on a antifuse layer.

13. The contact of claim 7 wherein said continuous conductive contact film comprises a top P+ silicon film formed on a silicide film.

14. The contact of claim 7 wherein said continuous conductive contact film comprises a top N+ silicon film formed on a silicide film.

15. The contact of claim 7 wherein said continuous conductive film is aluminum or an aluminum alloy.

Please add new claims:

26. (New) The contact of claim 13 wherein said silicide film comprises titanium silicide.

27. (New) The contact of claim 14 wherein said silicide film comprises titanium silicide.

A3
28. (New) The contact of claim 5 wherein said continuous conductor comprises a top p+ silicon film formed on a silicide film.

29. (New) The contact of claim 28 wherein said silicide film comprises titanium silicide.

30. (New) The contact of claim 5 wherein said continuous conductor comprises a top n+ silicon film formed on a silicide film.

31. (New) The contact of claim 30 wherein the silicide film comprises titanium silicide.

REMARKS

Affirmation of Election

Applicant hereby affirms his election to prosecute Group 1 claims, claims 1-15 drawn to a semiconductor device. Accordingly, Applicant has cancelled Group II claims, claims 16-25 drawn to a method of making a semiconductor device.

Claim Objections

The Examiner has objected to claims 1 and 5 for including informalities. Applicant has amended claims 1 and 5 to more particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

Claim Rejections - 35 U.S.C. § 112

The Examiner has rejected claim 4 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Applicant has amended claim 4 to more particularly point out and distinctly claim the subject matter which Applicant regards as the invention. As such, Applicant respectfully requests the removal of the 35 U.S.C. 112, second paragraph rejection of claim 4.

Claim Rejections – 35 U.S.C. § 102

The Examiner has rejected claims 1-8 and 15 under 35 U.S.C. § 102(e) as being anticipated by Lauvray et al. (US Patent 6,040,604). It is the Examiner's position that Lauvray discloses a conductive film 42 or 43. An opening filled with a metal having a top and bottom wherein the bottom is formed on the conductive film. It is the Examiner's position that Lauvray has dielectric layers 27, 24 and 21 and that they have an opening filled with a conductor (29,26,23) which is formed on the sidewalls. It is the Examiner's position that Lauvray teaches many unlabeled vertical and horizontal surfaces. A first vertical side extending up from the bottom of the contact (bottom of 43) of first horizontal surface 23 extending from said first vertical side to a second vertical side, and a second horizontal surface 26 extending from the second vertical side to a third vertical side.

It is Applicant's understanding that Lauvray fails to teach Applicant's invention as claimed in claims 1-8 and 15. Applicant's teach and claim an electrical contact between two or more different levels of conductors wherein the contact is formed through a plurality of film stacks. According to Applicant's claimed invention, a contact opening is formed through a plurality of film stacks in a "stair step" configuration. For example, in reference to Figure 1, contact opening 102 has a sidewall 104 with a stair step configuration formed through a plurality of film stacks 116. Because sidewall 104 has a "stair step" configuration a slope is built into the sidewall which enables a single continuous conductive film 112 to be easily deposited down the stair step configuration to make contact with a conductor below. The stair step sidewall 104 of the present invention allows a single continuous film to be deposited between top most levels of metallization and lower levels of metallization 114 enabling a low resistant contact to be made between the upper most levels of metallization to the lower most levels of metallization of an integrated circuit. Additionally, the stair step configuration enable a single continuous conductive film to electrically couple conductors in one level to conductors of another level or multiple other levels. Additionally, the slope of the sidewalls enables a single continuous film to be formed through a plurality of film stacks without creating voids therein.

It is Applicant's understanding that Lauvray fails to teach a contact as claimed by Applicant. In particular, it is Applicant's understanding that Lauvray fails to teach forming a "continuous conductive film" which is formed down the sidewalls of the contact openings as claimed by Applicant. It is Applicant's understanding that Lauvray teaches a standard multiplayer contact which is formed by the alternating formation of dielectric layers and conductive layers. For example, in Figure 1 of Lauvray first a dielectric layer 21 is formed then a conductor 23 is formed and then a dielectric 24 is formed then conductor 26 is formed then dielectric 27 is formed and then a conductor 29 is formed. In Lauvray, there is no single continuous conductive film which runs down the sidewalls of the contact opening. In Lauvray, the contact is formed by stacking each subsequent layer of metallization (23,26,29) upon the previous level. In Lauvray, three different metal films 29, 26 and 23 are used to form the metal conductor in the contact opening. As such, Lauvray fails to teach "a continuous conductive film" which is formed along the sidewalls of the contact opening as claimed by Applicant.

As such, for the above mentioned reasons, it is Applicant's understanding that the cited reference clearly fails to teach Applicant's invention as claimed in claims 1-8 and 15. Applicant, therefore, respectfully request the removal of the 35 U.S.C. § 102 rejections of claims 1-8 and 15 and seeks an early allowance of these claims.

If there are any additional charges, please charge Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: 6/4/02

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